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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 09/667,077 | 09/21/2000 | Xiao Chen | 99-463 | 9032 |

7590 05/03/2004
Steve D Lundquist
Caterpillar Inc
Intellectual Property Department
AB6490 100 NE Adams Street
Peoria, IL 61629-6490

EXAMINER

BARNES, CRYSTAL J

| ART UNIT | PAPER NUMBER |
|----------|--------------|
|----------|--------------|

2121

DATE MAILED: 05/03/2004

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Please find below and/or attached an Office communication concerning this application or proceeding.

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Office Action Summary

Application N .

09/667,077

Applicant(s)

CHEN ET AL.

Examiner

Crystal J. Barnes

Art Unit

2121

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 22 March 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-10 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 1-9 is/are allowed.
- 6) ☒ Claim(s) 10 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 21 September 2000 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

1. The following is a Final Office Action in response to Amendment received on 22 March 2004. New claim 10 has been added. Claims 1-10 are now pending in this application.

Response to Arguments

2. Applicant's arguments, see Remarks pages 6-7, filed 22 March 2004, with respect to the rejection of claims 1-4 and 6-9 under 35 USC 103(a) have been fully considered and are persuasive. The rejection of the rejection of claims 1-4 and 6-9 under 35 USC 103(a) has been withdrawn.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over USPN 6,023,637 to Liu et al. in view of USPN 6,270,599 B1 to Wood.

As per claim 10, the reference discloses a method for determining a thermal analysis of a welding process as a function of an analytical solution model, including the steps of: determining a set of adiabatic boundary conditions (see column 2 lines 44-48, "boundary conditions") of the material being welded; determining a set of reflected heat sources (see column 6 lines 22-24, "multiple heat sources") as a function of the adiabatic boundary conditions ("boundary conditions"); determining a set of point heat sources (see column 6 lines 22-24, "multiple single point sources") as a function of the reflected heat sources ("multiple heat sources"); and determining a total analytical solution from superposition ("superposition") of the point heat sources ("multiple single point sources").

The Liu et al. reference does not expressly disclose material being welded.

The Wood reference discloses

(see column 3 lines 45-48, "A welding head 15 ... thermal imaging camera 16 for inspection and verification ...")

(see column 6 lines 59-62, "The thermal imaging camera 16 ... detect failures of the weld and monitor consistency on-line.")

(see column 6 lines 64-65, "Temperature gradients are monitored over the width of the weld ...")

(see column 7 lines 1-2, "Information from the image can locate points where full welding contact has failed ...")

(see column 8 lines 1-8, "... thermal imaging camera 16 sees a thermal signal ...")

At the time the invention was made, it would have been obvious to a person of ordinary skill in the art to modify the method and apparatus for thermal radiation imaging taught by the Liu et al. reference with the image data from the thermal imaging camera taught by the Wood reference to process thermal image data from a welding process.

One of ordinary skill in the art would have been motivated to process thermal image data from a welding process to reveal meaningful information about internal sources of thermal energy.

Allowable Subject Matter

5. Claims 1-9 are allowable.

6. The following is an examiner's statement of reasons for allowance:

As per claim 1, the prior art of record taken alone or in combination fail to teach delivering the finite element analysis mesh coordinates to a thermal analysis model, the thermal analysis model including an analytical solution model and a finite

Art Unit: 2121

element analysis model; determining a thermal analysis of the welding process as a function of at least one of the analytical solution model and the finite element analysis model, the analytical solution model being adapted to provide a thermal history of the welding process for a global distortion analysis, and the finite element analysis model being adapted to provide a thermal history of the welding process for a detailed residual stress analysis.

As per claim 8, the prior art of record taken alone or in combination fail to teach a thermal analysis model adapted to receive the finite element analysis mesh, determine a thermal analysis of the welding process, and responsively provide a thermal history of the welding process, wherein the thermal analysis model includes: an analytical solution model adapted to provide a thermal history of the welding process for a global distortion analysis; and a finite element analysis model adapted to provide a thermal history of the welding process for a detailed residual stress analysis; and a structural analysis model adapted to provide a structural analysis of the welding process as a function of the thermal history.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

The following patents are cited to further show the state of the art with respect to simulation of welding/bonding processes in general:

USPN 4,596,917 to Nied et al.

USPN 5,202,837 to Coe et al.

USPN 5,552,575 to Doumanidis

USPN 6,186,011 B1 to Wung et al.

USPN 6,424,879 B1 to Chilese et al.

JPPN 10187769 A to ONOMURA et al.

M. Nakahira et al., "Evaluation of Welding Deformation on ITER

Vacuum Vessel", 18th Symposium on Fusion Engineering, 25-29

October 1999, pages 245-248.

Y. Takahashi et al., "Numerical Analysis of the Interfacial Contact

Process in Wire Thermocompression Bonding", IEEE

Transactions on Components, Packaging, and Manufacturing

Technology, Part A, Volume 19, Issue 2, June 1996, pages 213-

223.

Art Unit: 2121

8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Crystal J. Barnes whose telephone number is 703.306.5448. The examiner can normally be reached on Monday-Friday alternate Mondays off.

Art Unit: 2121

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Anthony Knight can be reached on 703.308.3179. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

cjb
26 April 2004



Anthony Knight
Supervisory Patent Examiner
Group 3600